

Sandia National Labs Energy Storage Technologies & Systems

Energy Storage Use Cases

Expanded Examples & Explanations

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Singapore

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
SANDIA REPORT
SANDIA-2015-0002
Energy Storage
Presented November 2015

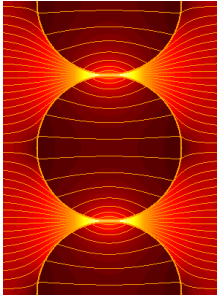
**Evaluating Utility Procured Electric
Energy Storage Resources: A
Perspective for State Electric Utility
Regulators**

A Study for the DOE Energy Storage Systems Program

Chris Stangler and Mike Liden

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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SAND Number: **2015-6343C**

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Utility Use Case



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- *Cordova Hydroelectric / Flywheel Feasibility Study*

- Players

- Cordova Electric Cooperative (CEC)
- DoE/OE and Sandia National Labs (SNL)
- Alaska Center for Energy and Power (ACEP)

- Issue

- Expansion of fishing industry has exceeded the supply capability of the 8.5MW hydroelectric plants which supplemental power demand is met with diesel generation (\$65,000 per year).
 - Supplemental power by diesel generation is only needed for minutes
 - Hydro units are run with a 500kW reserve which energy storage can free up with flywheel as technology of interest and defer diesel generation
- ACEP, in partnership with SNL, has developed an energy balance model to determine feasibility of flywheel



Utility Use Case



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- *Cordova Hydroelectric / Flywheel Feasibility Study*
- Member-owned COOP serving 2,000 customers with summer load peak of 8.4MW
- Generation Assets
 - Pump Creek: 2 hydro units, 3MW each
 - Humpback Creek: 2 hydro units, 1.25MW each
 - Orca Power Plant: 5 diesel units, Total of 9.8MW
- Distribution system is underground
- SCADA system records over 200 channels of system data at 1 second intervals with over 10 years worth of data



Utility Use Case



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- *Results of Energy Balance Model*
- Total hours per year within 500kW of Spinning Reserve while running on Hydro Power was 215.9167 Hours
- Total Displaceable Diesel hours is 185.4589 hours
- Assuming electricity cost of \$0.45 / kWh, economic value of energy storage systems is ~\$54,640 / year
- Power Class energy storage system will not have significant economic benefit for Cordova if used for diesel displacement

Utility Use Case

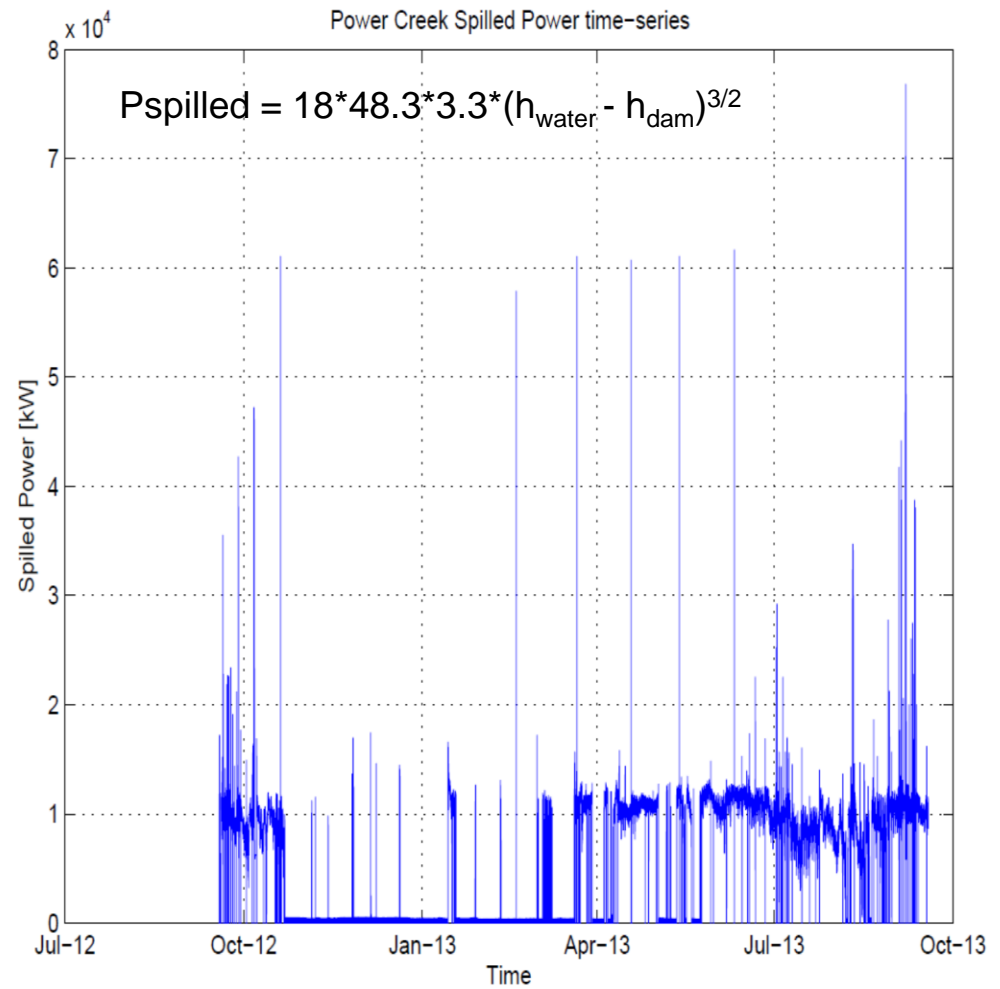


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- *Cordova Hydroelectric / Flywheel Feasibility Study*
- Recovering water spilled during times when load demand is below the hydropower capacity has a beneficial impact
- Initial economic benefit of \$750,000 / year off-setting thermal loads. (~14x better return than diesel displacement)



Commercial Use Case

- *Two Story Office Building*
- Location
 - Near Ocean
 - Hot and Humid Summer and Snowy Winters
 - \$4.80 per kW Demand Charge per Month
- Building Processes
 - Emergency Response Dispatch (computers, communications, garage)
 - General Load (sump pump, lights, plug loads, HVAC)
 - 13 kW Peak, 224 kWh
- Applications
 - UPS
 - Time of Use (Arbitrage)
 - Demand Charge (Peak Reduction)
 - Demand Charge and Time of Use

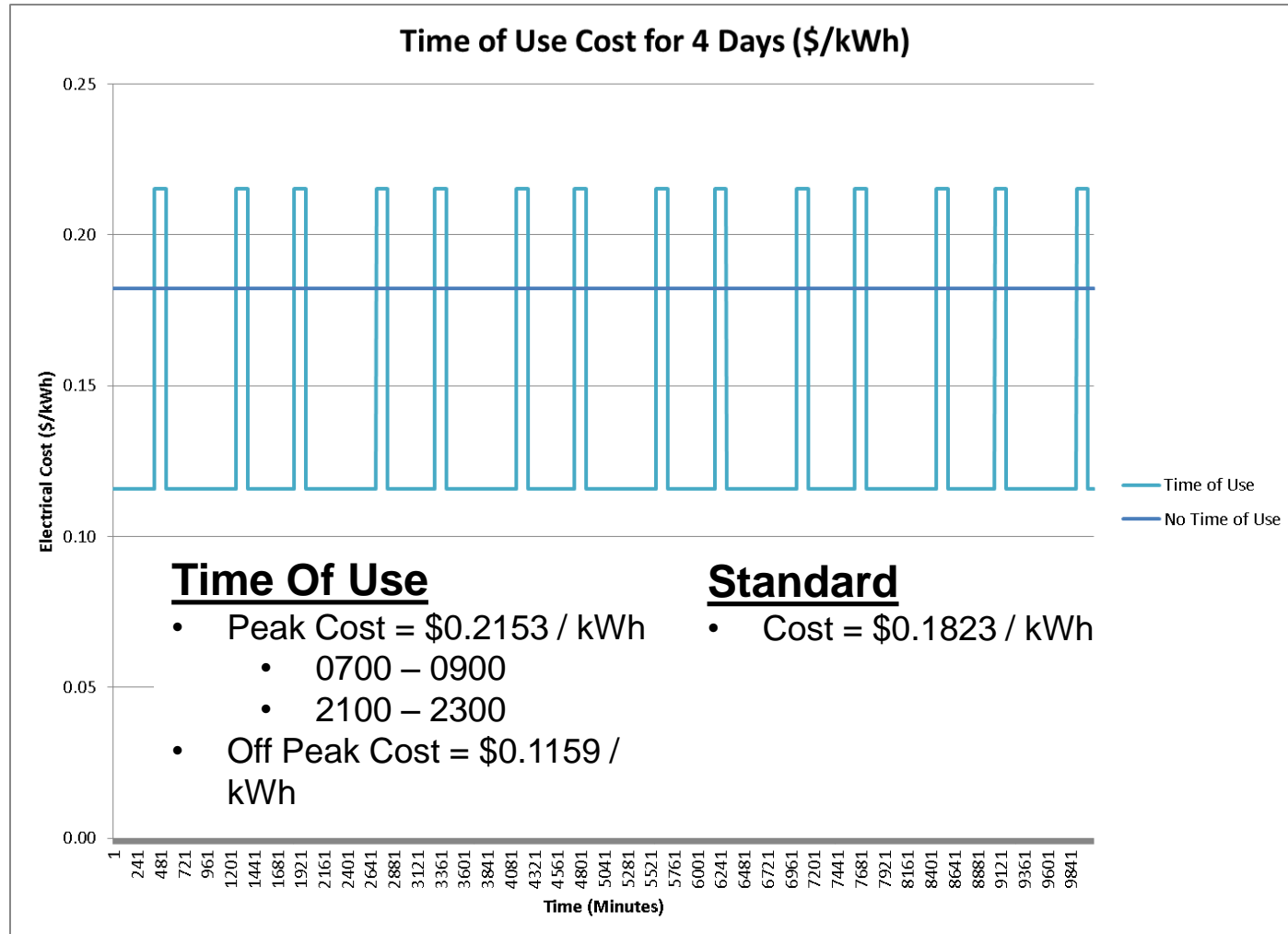
Commercial Use Case



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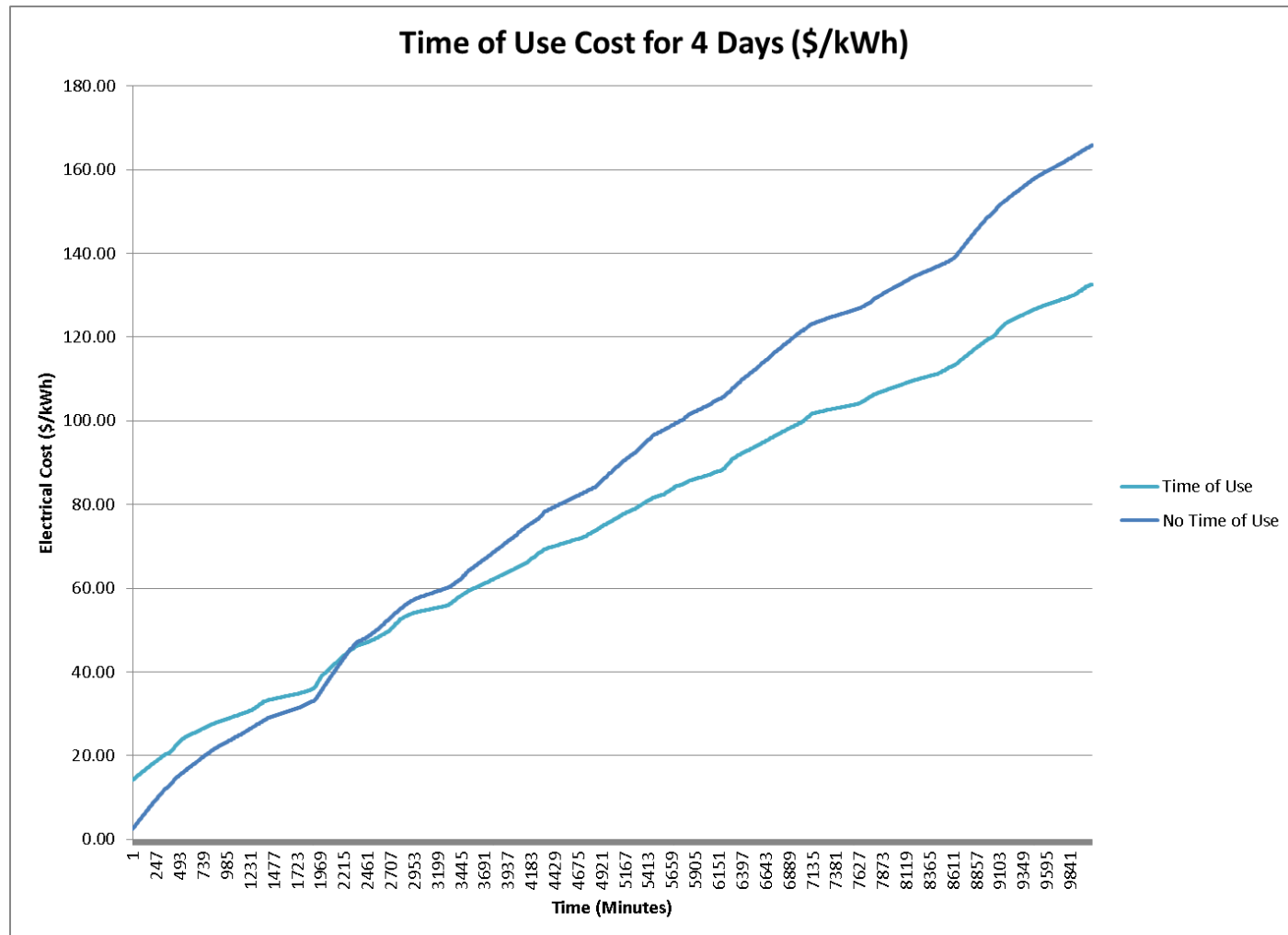


■ *Two Story Office Building*



Commercial Use Case

■ *Electricity Cost*



Commercial Use Case



- *Yearly Costs Without Energy Storage*
- Standard
 - Connection Fee = \$29.52
 - Electricity Cost = \$14,902.95
 - Demand Charge = \$711.36
 - Total Cost per Year = **\$15,643.83**
- Time of Use
 - Connection Fee = \$170.28
 - Electricity Cost = \$10,801.82
 - Demand Charge = \$711.36
 - Total Cost per Year = **\$11,683.46**
- Savings
 - Time of Use Saves per Year = **\$3,960.37**

Commercial Use Case



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■ *Time of Use (Arbitrage)*

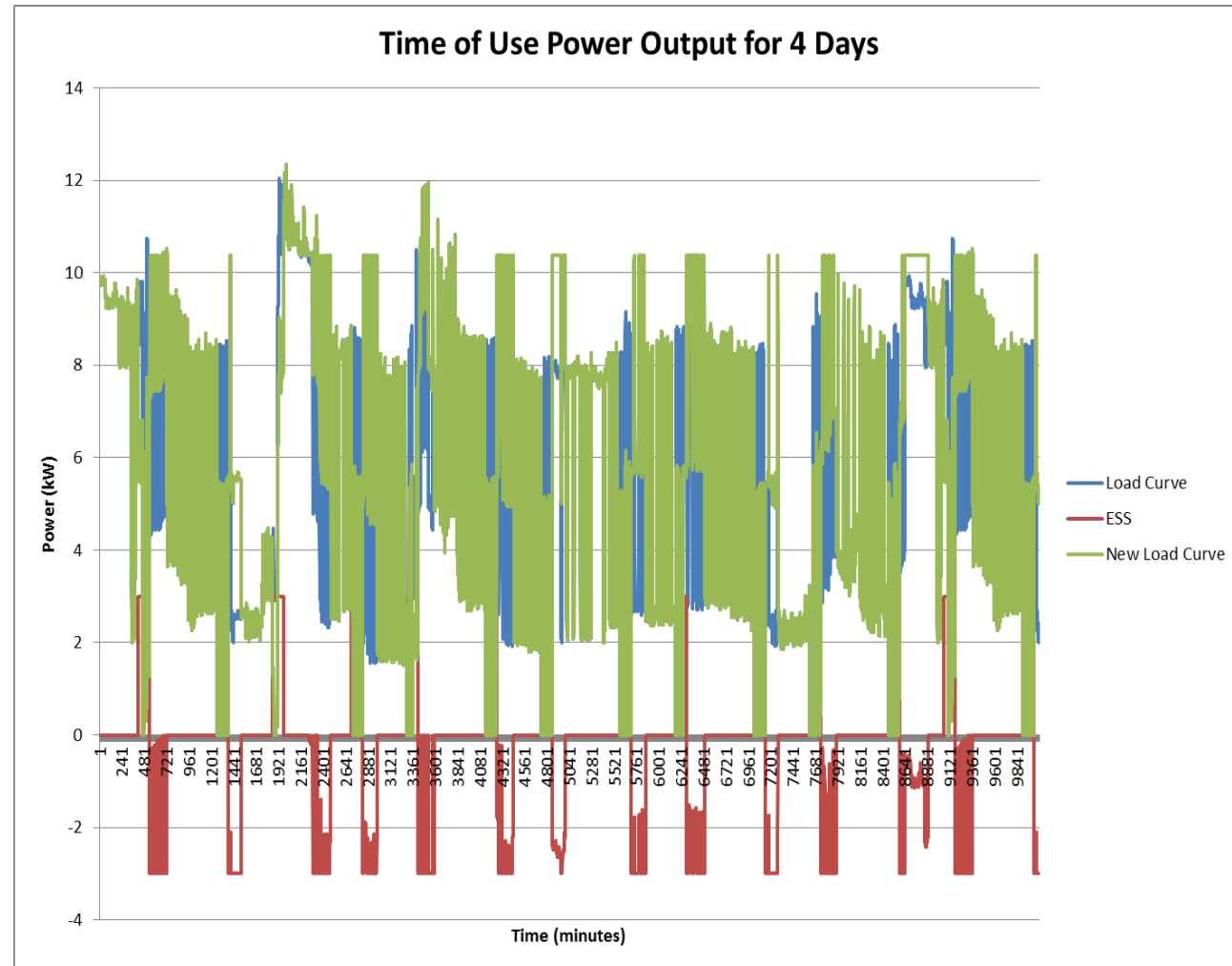
Energy Storage

- Li-Ion
- Round Trip Efficiency = 80%
- Power Rating = 3 kW
- Energy Rating = 20 kWh

System Cost = **\$13,500.00**

Savings per Year = **\$550.80**

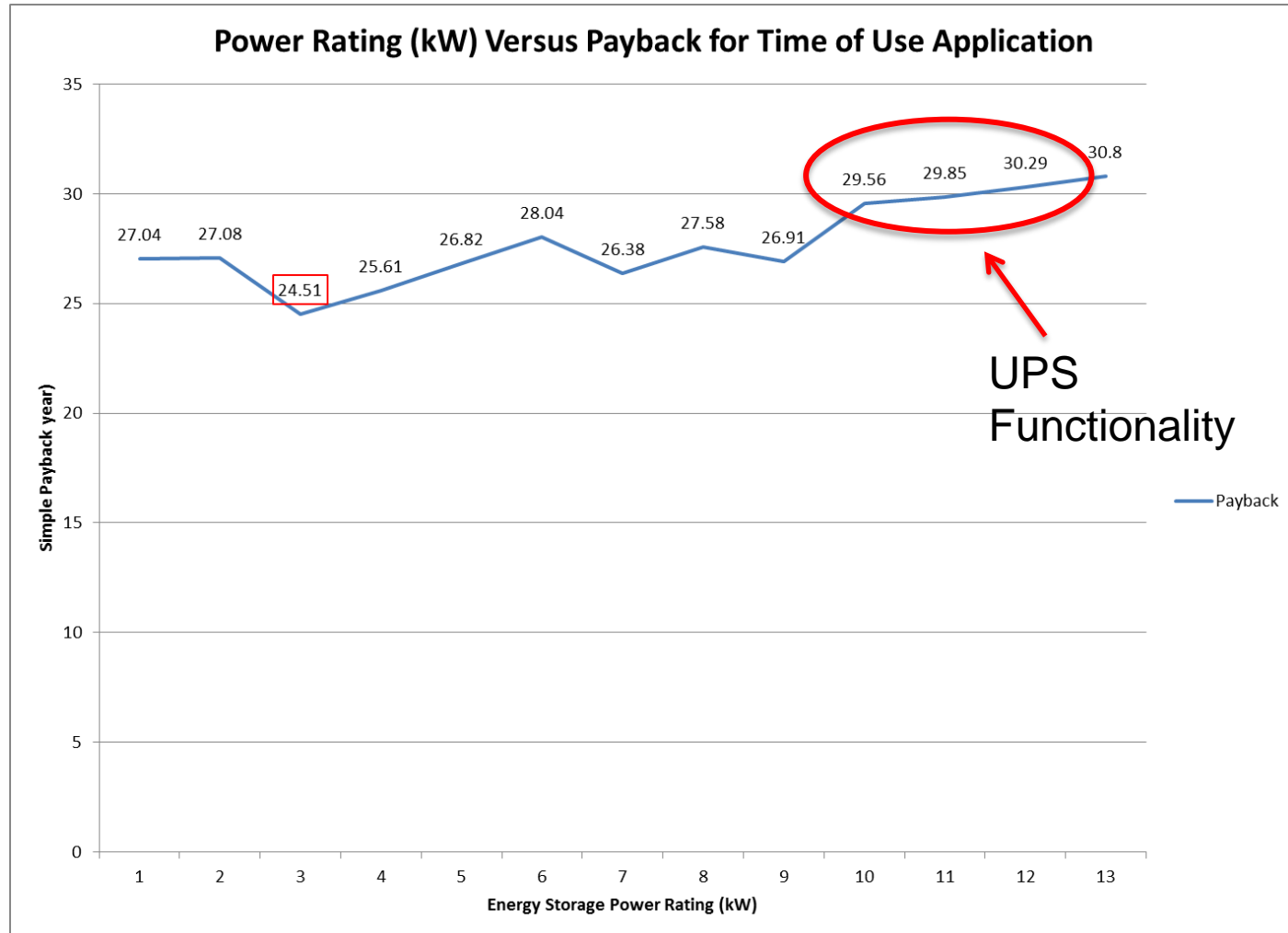
Simple Pay Back = **24.51 years**



Commercial Use Case



- *Time of Use (Arbitrage)*



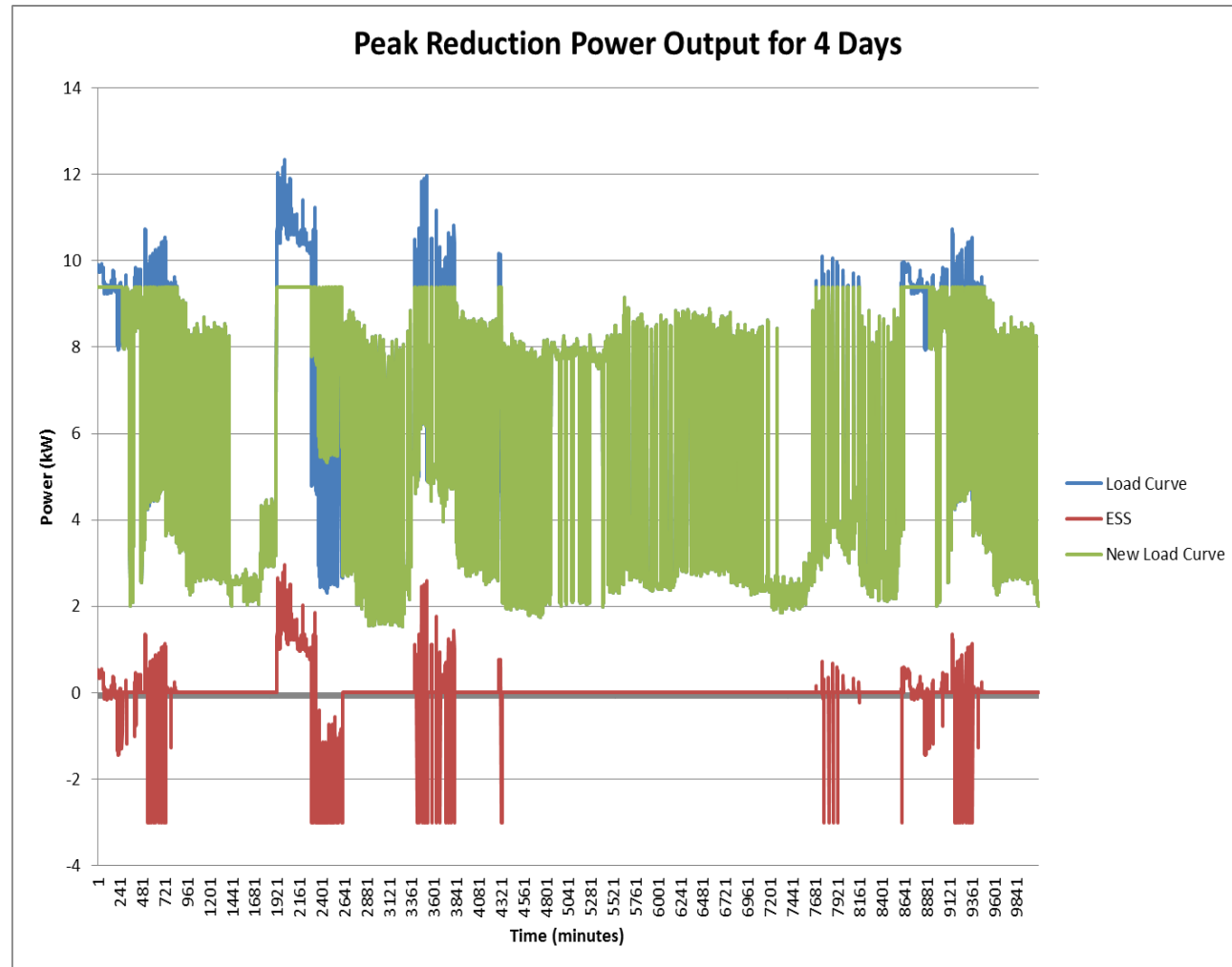
Commercial Use Case

■ Demand Charge (Peak Reduction)

Energy Storage

- Li-Ion
- Round Trip Efficiency = 80%
- Power Rating = 3 kW
- Energy Rating = 4 kWh
- Peak Reduction = 24%

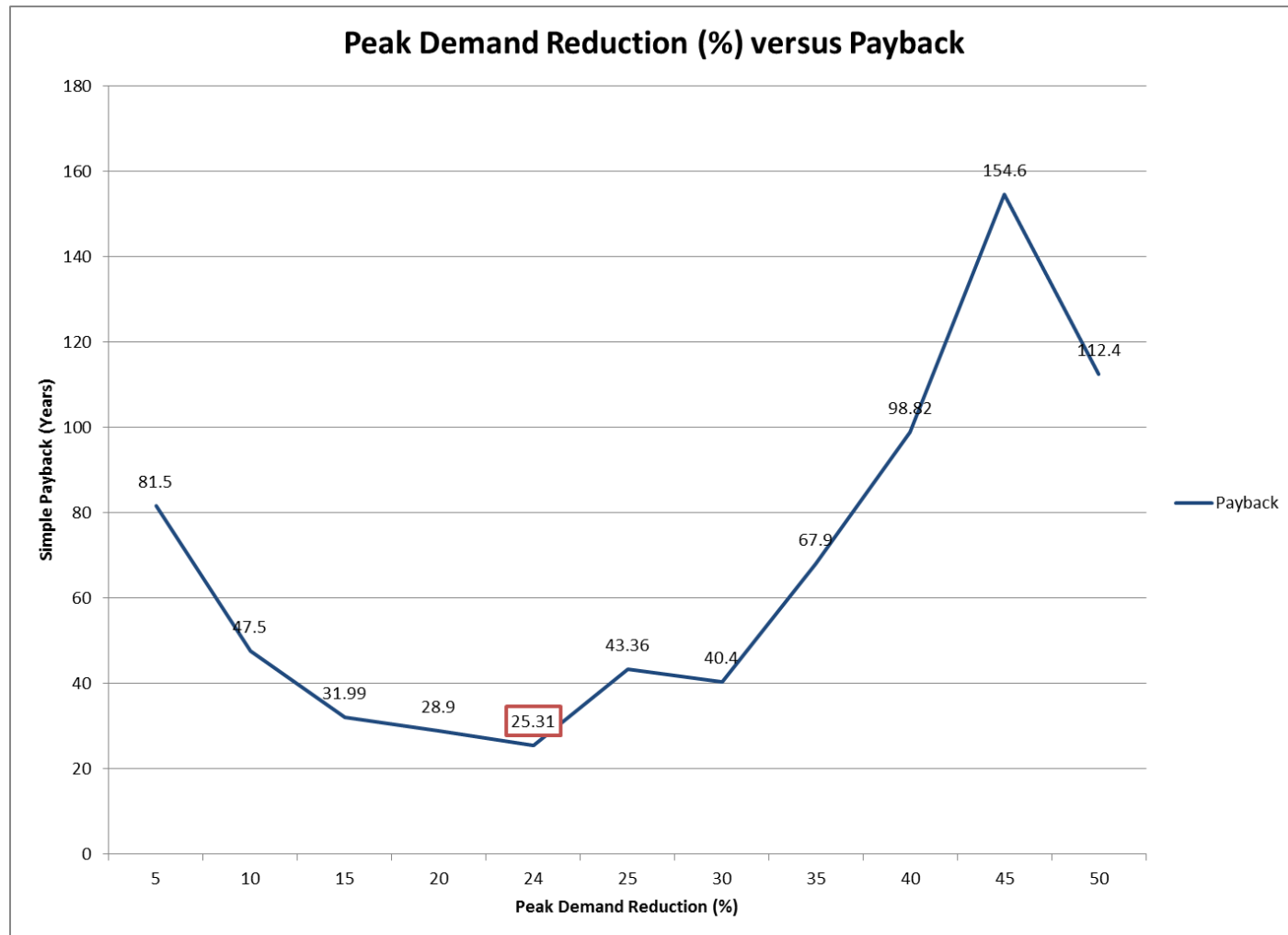
System Cost = **\$3,900.00**
Savings per Year = **\$154.11**
Simple Pay Back = **25.31 years**



Commercial Use Case



- *Demand Charge (Peak Reduction)*



Commercial Use Case



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■ *Demand Charge and Time of Use*

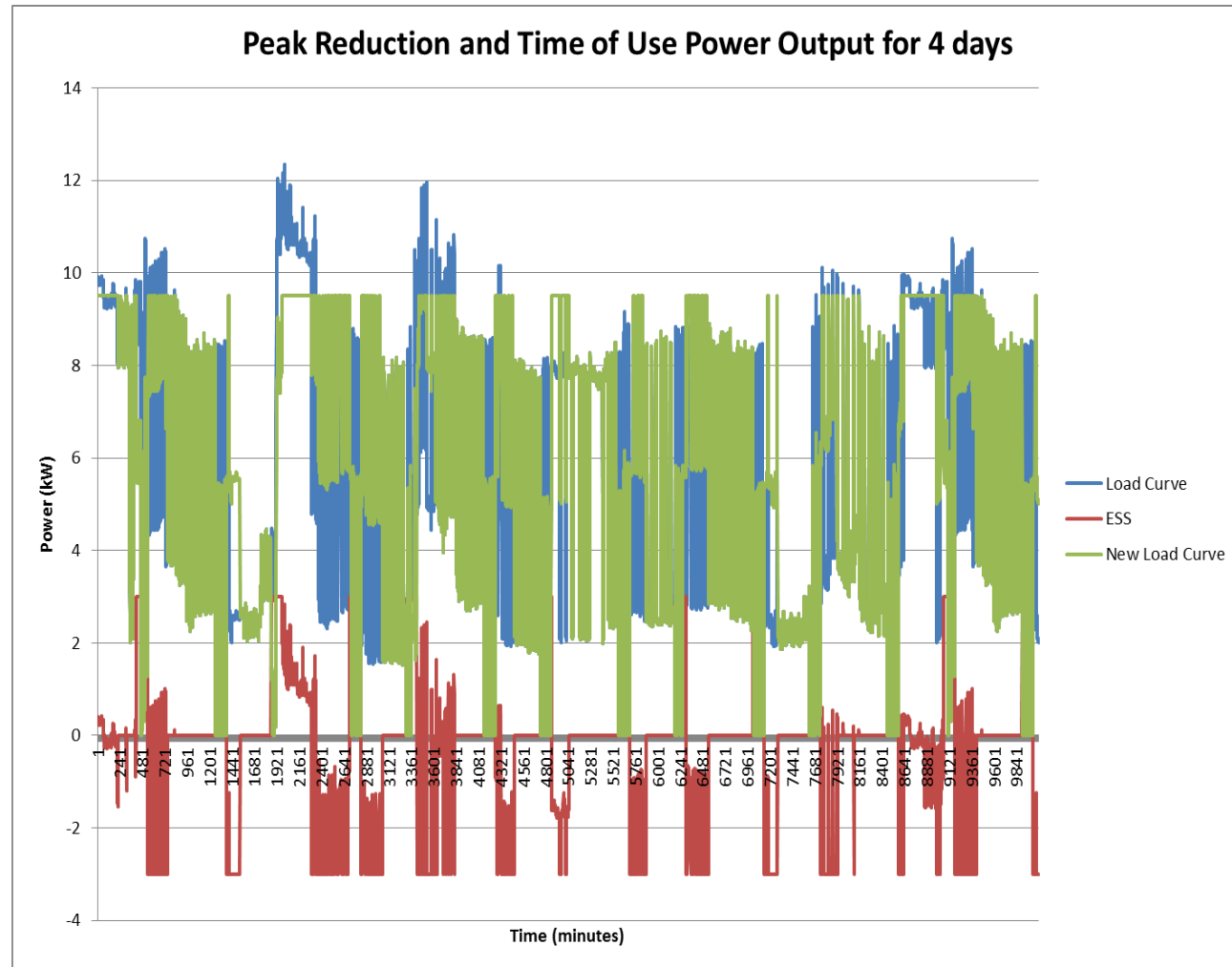
Energy Storage

- Li-Ion
- Round Trip Efficiency = 80%
- Power Rating = 3 kW
- Energy Rating = 24 kWh
- Peak Reduction = 23%

System Cost = **\$15,900.00**

Savings per Year = **\$688.85**

Simple Pay Back = **23.08 years**



Commercial Use Case

- *Two Story Office Building*
- Summary
 - Fastest Payback
 - Time of Use (Arbitrage) = 3 kW
 - Demand Charge (Peak Reduction) = 24% of Monthly Peak
 - Combining the Demand Charge (Peak Reduction) and the Time of Use (Arbitrage) saves the most money
 - Peak Reduction in the combined applications was reduced by 1% due to energy storage charging

Residential Use Case



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- *Single Family Home*
- Location
 - Desert
 - Hot Summer and Cool Winters
 - Peak Hour Price (\$0.13 / kWh) and Off Peak Hour Price (\$0.07 / kWh)
- Building Processes
 - Single Family Home
 - General Load (refrigerator, kitchen, lights, plug loads, HVAC)
 - 4.56 kW Peak, 1600.06 kWh per Month
- Applications
 - UPS
 - Time of Use (Arbitrage)

Residential Use Case

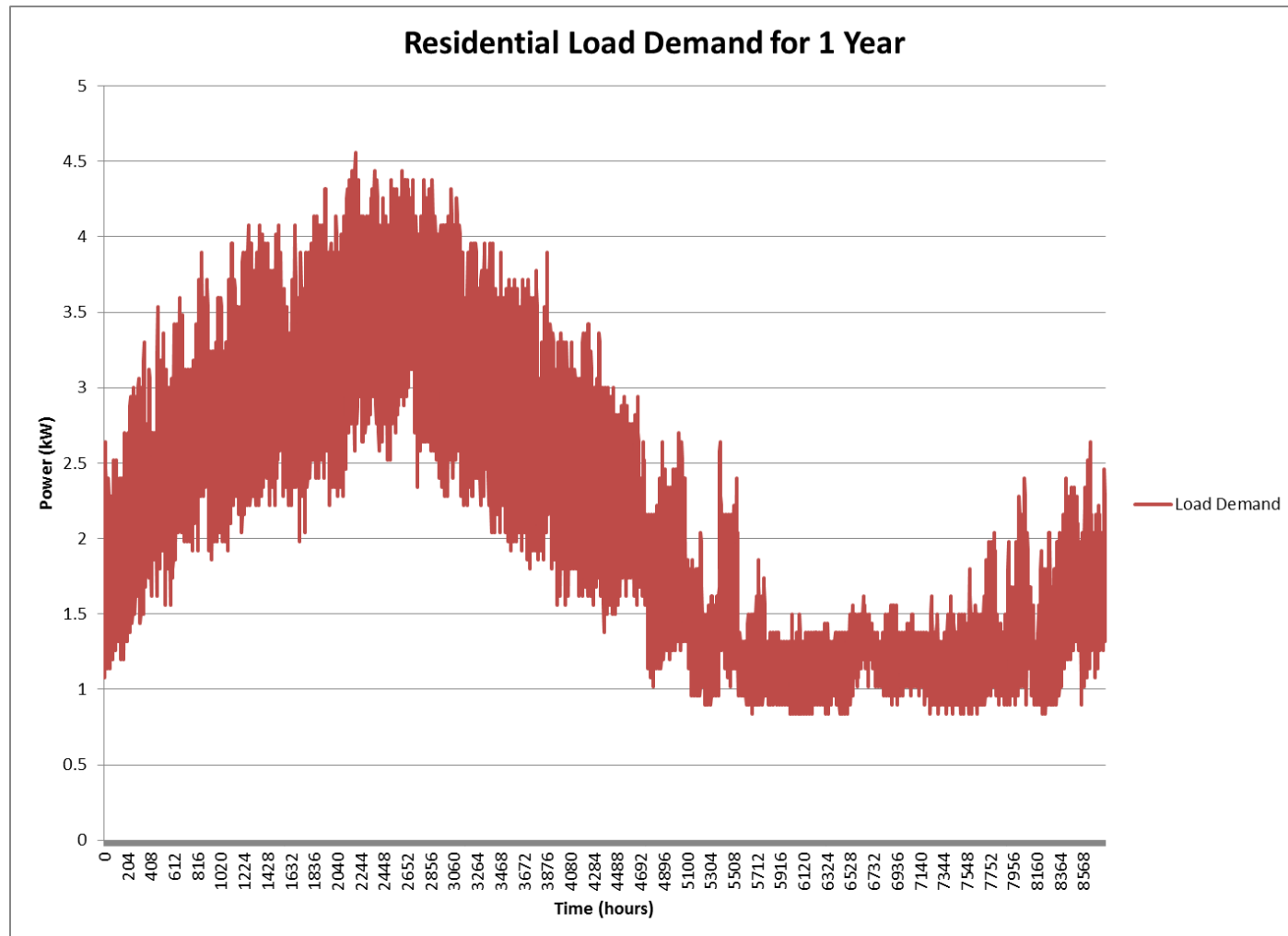


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- *Single Family Home*



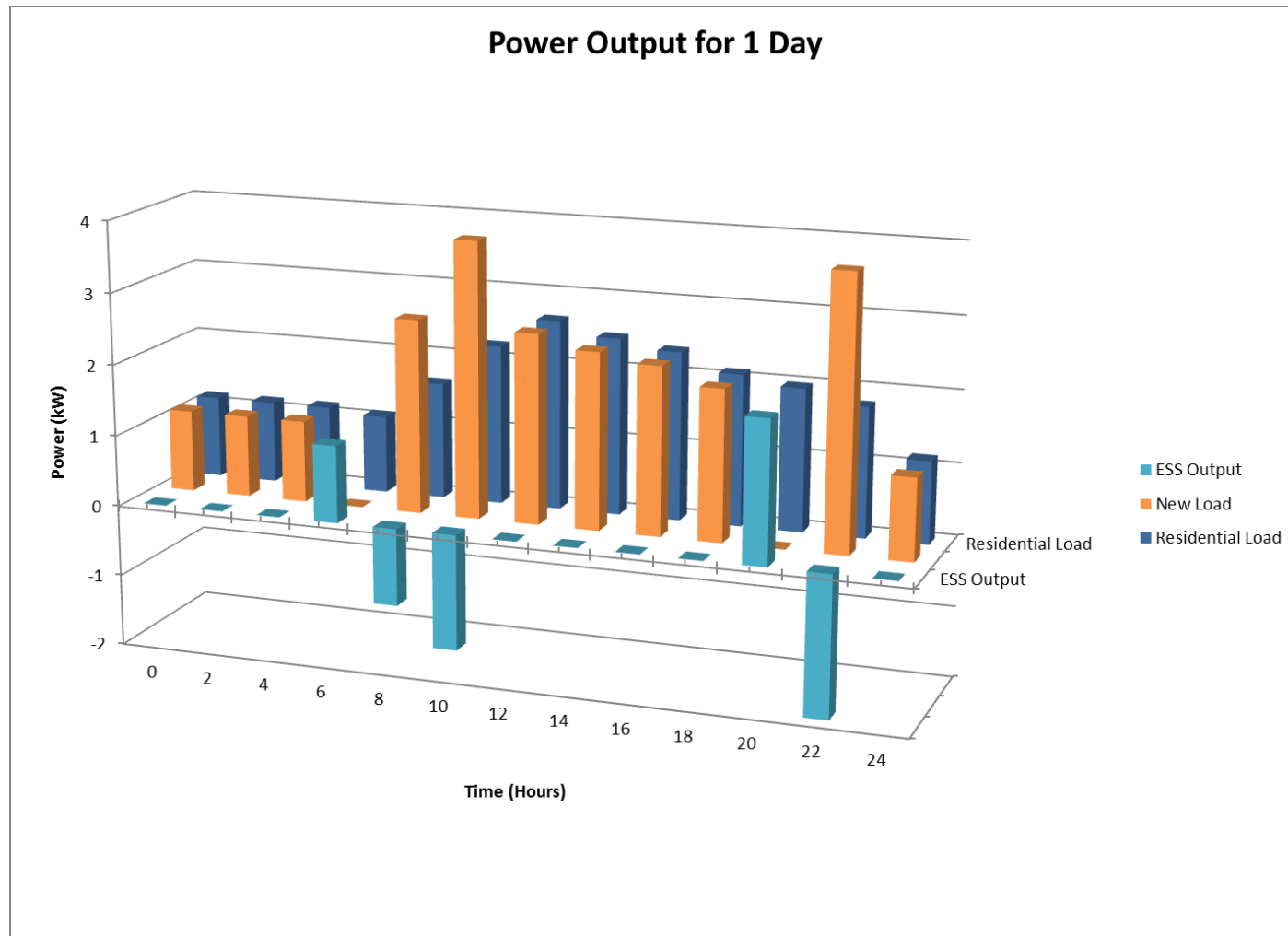
Residential Use Case



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- *Arbitrage*



Residential Use Case



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■ Arbitrage

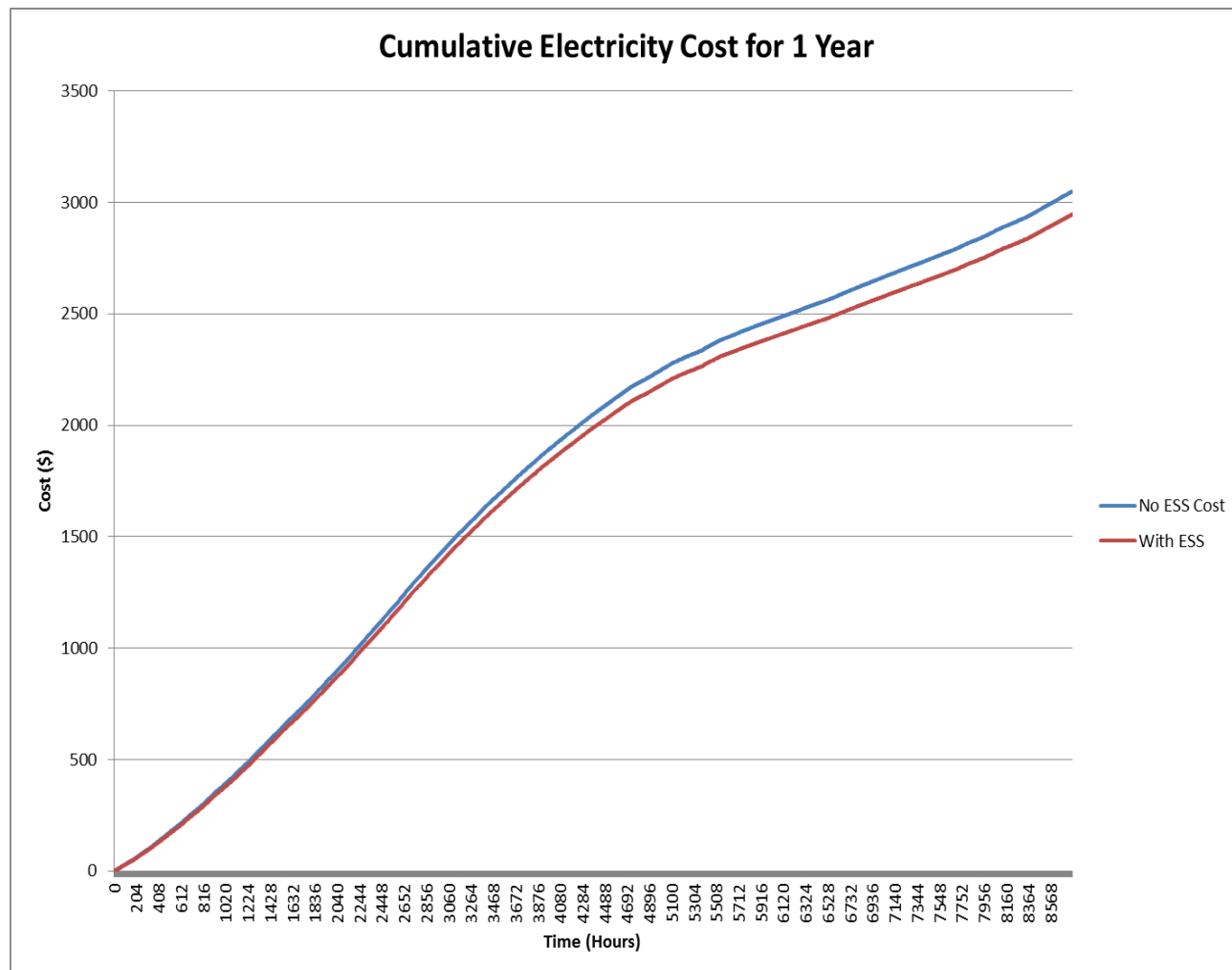
Energy Storage

- Li-Ion
- Round Trip Efficiency = 80%
- Power Rating = 2 kW
- Energy Rating = 4 kWh
- Peak Reduction = 23%

System Cost = **\$3,400.00**

Savings per Year = **\$103.28**

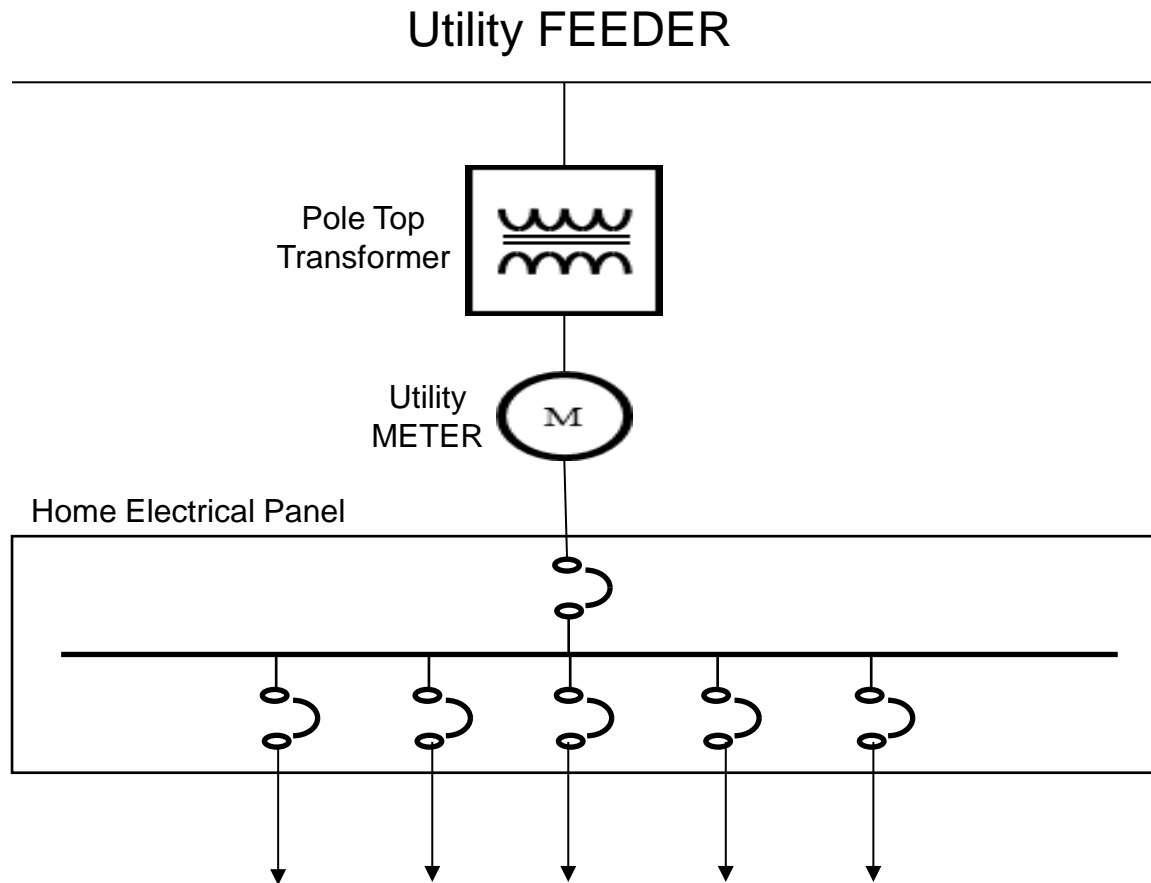
Simple Pay Back = **32.9 years**



Residential Use Case



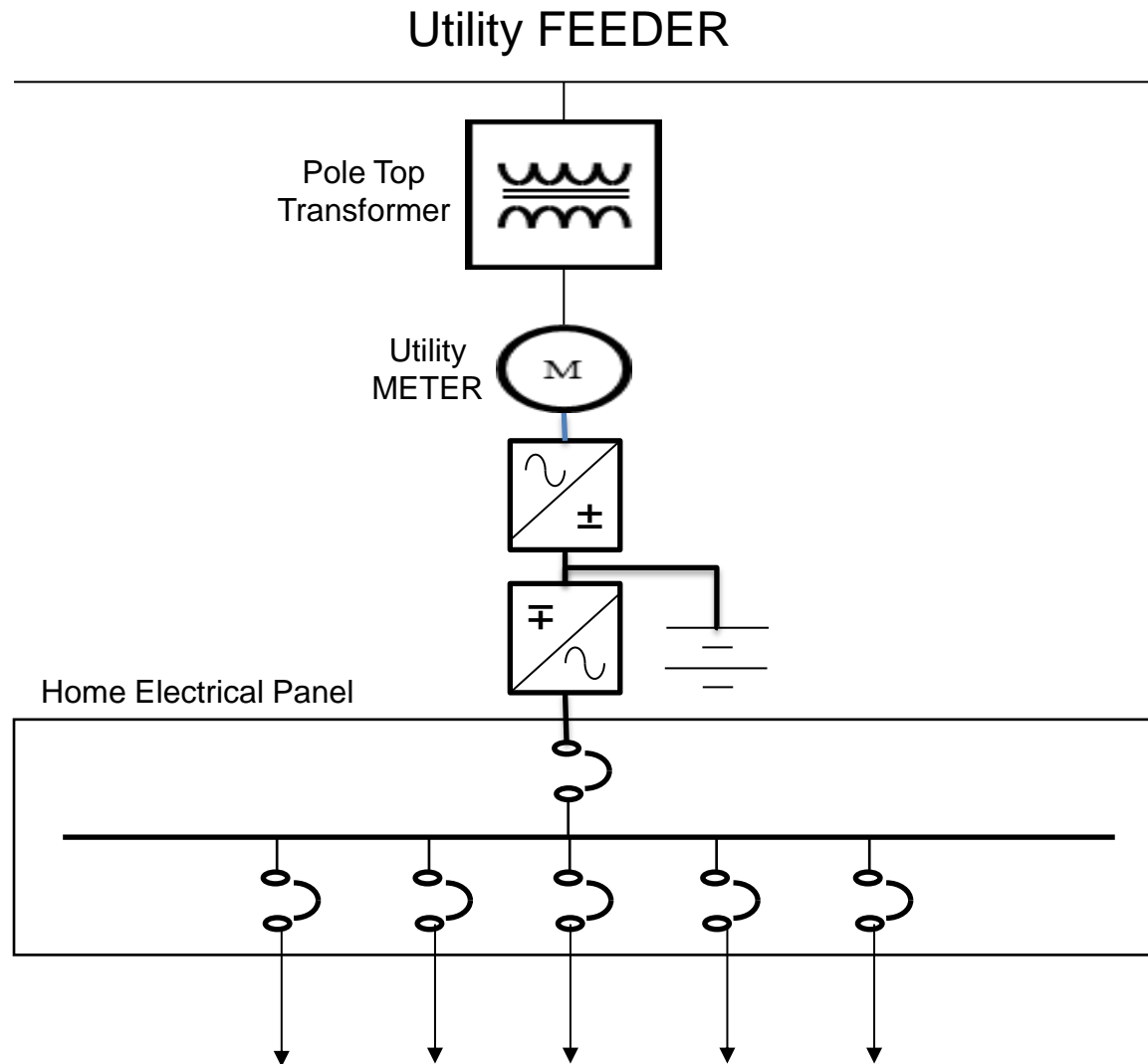
- *UPS*



Residential Use Case



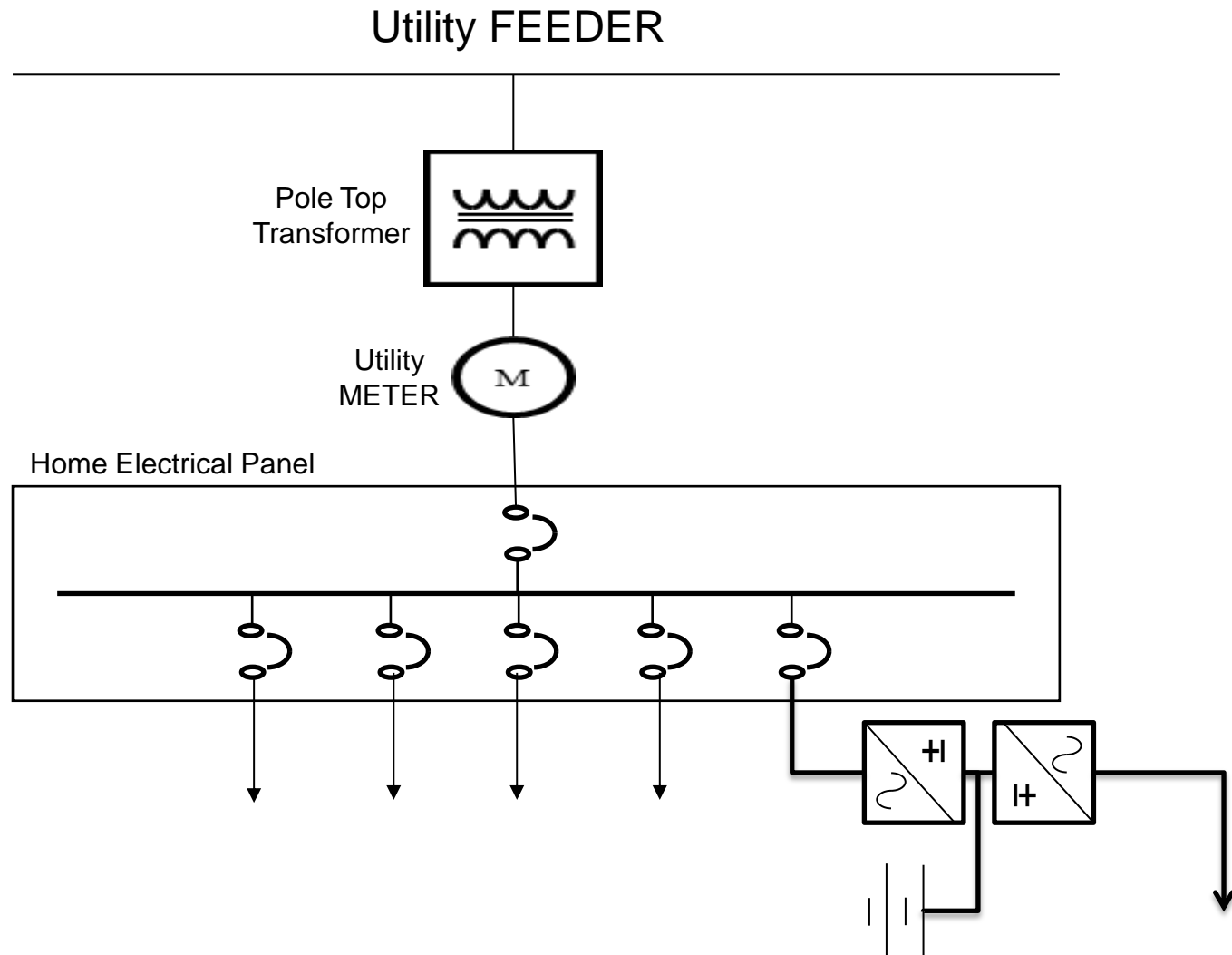
- *UPS Entire House*



Residential Use Case



- *UPS Critical Load*



Contact Information

Thank you!

Questions?

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